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Attorney's Docket No.: 074451.P024C PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of:)
)
Zandi, et al.)
) Examiner: Johnson, T.
Application No: 08/941,466)
) Art Unit: 2623
Filed: September 20, 1997)
)
For: METHOD FOR COMPRESSION USING)
REVERSIBLE EMBEDDED WAVELETS)

Assistant Commissioner For Patents
Washington, D.C. 20231

APPEAL BRIEF
IN SUPPORT OF APPELLANT'S APPEAL
TO THE BOARD OF PATENT APPEALS AND INTERFERENCES

Dear Sir:

Applicant (hereafter "Appellant") hereby submits this Brief in triplicate in support of its appeal from a final decision by the Examiner, mailed March 19, 2002, in the above-referenced case. Appellant respectfully requests consideration of this appeal by the Board of Patent Appeals and Interferences for allowance of the present patent application.

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I. <u>REAL PARTY IN INTEREST</u>

The present U.S. Patent application is assigned to Ricoh Company Ltd., a corporation of Japan having a place of business in Tokyo, Japan and to Ricoh Corporation at 2882 Sand Hill Road, Suite 115, Menlo Park, California, 94025.

II. <u>RELATED APPEALS AND INTERFERENCES</u>

To the best of Appellant's knowledge, there are no appeals or interferences related to the present appeal which will directly affect, be directly affected by, or have a bearing on the Board's decision.

III. <u>STATUS OF THE CLAIMS</u>

Claims 1, 4-8, 12, 13 and 15-52 are pending in the present application. Claims 2, 3, 9-11 and 14 have been canceled during prosecution. Claims 1, 4-8, 12, 13 and 15-52 were rejected in the Final Office Action mailed March 19, 2002 and are the subject of this appeal.

Claims 1, 4-8, 12, 13 and 15-38 were rejected as being unpatentable over the combination of Jerome M. Shapiro "Embedded Image Coding Using Zerotrees of Wavelet Coefficients," IEEE Transactions on Signal Processing, Vol. 41, No. 12, pp. 3445-3462 December 1993 (*Shapiro*) in view of J. W. Woods and S. D. O'Neil, "*Subband coding of images*," IEEE Trans. Acoustics, Speech, and Sig. Proc., vol. 34, pp. 1278-1288, Oct. 1986 (*Woods*) and U.S. Patent No. 5,455,874 issued to Ormsby, et al. (*Ormsby*) and either Pollara, F. and Chen, T. "Rate-Distortion Efficiency of Subband Coding with Integer Coefficient Filters," IEEE International Symposium on Information Theory, pg. 419, June 1994 (*Pollara*) or Applicant's Admitted Prior Art.

Claims 44-50 were rejected as being unpatentable over *Shapiro* in view of *Woods*, *Ormsby* and either *Pollara* or Applicant's Admitted Prior Art in further view of U.S. Patent No. 5,495,292 issued to Zhang, et al. (*Zhang*).

Claims 39, 40 and 42 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Shapiro* in view of *Woods* and either *Pollara* or Applicant's Admitted Prior Art.

Claims 41 and 43 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Shapiro* in view of *Woods* and either *Pollara* or Applicant's Admitted Prior Art and further in view of *Ormsby*.

Claims 51 and 52 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Shapiro* in view of *Woods* and either *Pollara* or Applicant's Admitted Prior Art in further view of *Zhang*.

Claims 25-31 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Shapiro in view of *Woods* and *Ormsby* and either *Pollara* or Applicant's Admitted Prior Art in further view of either *Hartung* or *Shinichi*.

IV. STATUS OF AMENDMENTS

In response to the Final Office Action mailed March 19, 2002, rejecting claims 1, 4-8, 12, 13 and 15-52, Applicants submit this appeal brief. A copy of all claims on appeal is attached hereto as Appendix A.

V. SUMMARY OF THE INVENTION

The invention includes a method and apparatus for generating transformed signals in response to input data. See Summary of the Invention at page 6, lines 2-4. The input

data can be a variety of data types, for example, still images, video, audio, etc. See Detailed Description at page 15, lines 5-7. In one embodiment, the transformed signals are generated using a reversible wavelet transform. The invention also includes a method and apparatus for compressing the transformed signals into data representing a losslessly compressed version of the input data. Elements of the encoding and/or the decoding portion of the invention may be implemented in hardware or software, such as that used on a computer system. See Detailed Description at page 34, lines 4-6.

In one embodiment, the reversible wavelet transform is implemented using a set of filters. See Detailed Description at page 18, lines 14-26. In one embodiment, the invention decomposes the input data using a non-minimal length reversible filter. See Summary of the Invention at page 6, lines 5-10. In one embodiment, the filters are a two-tap low-pass filter and a six-tap high-pass filter. In one embodiment, these filters are implemented using only addition and subtraction operations (plus hardwired bit shifting). See Detailed Description at page 18, lines 14-26. In one embodiment, a two/ten (TT-filter) is used, which has the property that the filter has no response to a cubically increasing function. The Two/Ten filter can be implemented with a total of seven additions and subtractions. See Detailed Description at page 29, lines 6-17.

The invention also includes a method and apparatus to perform coding of the transformed signals. Using the combination of zerotree order coding and/or horizon order coding, the invention provides bit-significance encoding to the coefficients generated by the reversible wavelets. See Detailed Description at page 64, lines 12-14. In one embodiment, a one-pass transform is used that allows the input data in the system to be

completely processed as the data is received. See Detailed Description at page 70, lines 5-7.

In one embodiment, formatted coefficients are subjected to either frequency-based modeling or joint spatial frequency (JSF) modeling. When the input data comprises image data having multiple bitplanes, a number of bitplanes are encoded with frequency-based modeling, while the remaining bitplanes are encoded with JSF modeling. See Detailed Description at page 17, lines 3-8.

In one embodiment, the high-order bitplanes of the coefficients are ordered and coded with the frequency-based modeling by prediction of significance of the coefficient bits related to the pyramidal structure of the wavelet. The low-order coefficient bitplanes are ordered and encoded with the JSF context model, for example horizon modeling. See Detailed Description at page 17, lines 9-16. In one embodiment, the bit streams resulting from the frequency-based context model circuitry and the JSF model circuitry are encoded in order of significance using an entropy encoder. See Detailed Description at page 17, line 24 to page 18, line 1.

The invention also includes a method and apparatus for decompressing the losslessly compressed version of the input data into transformed signals. The invention also provides for lossy compression of input signals by truncation of losslessly compressed data. An inverse decomposition using non-minimal length, overlapped reversible filters implemented in integer arithmetic is used to generate a reconstructed version of the original data. The decompression may be performed by using multiple one-dimensional filters. See Summary of the Invention at page 6, lines 10-11.

VI. <u>ISSUES PRESENTED</u>

(1) Whether claims 1, 4-8, 12, 13 and 15-38 were properly rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of *Shapiro* in view of *Woods* and *Ormsby* and either *Pollara* or Applicant's Admitted Prior Art.

(2) Whether claims 44-50 were properly rejected under 35 U.S.C. § 103(a) as being unpatentable over *Shapiro* in view of *Woods*, *Ormsby* and either *Pollara* or Applicant's Admitted Prior Art in further view of *Zhang*.

(3) Whether claims 39, 40 and 42 were properly rejected under 35 U.S.C. § 103(a) as being unpatentable over *Shapiro* in view of *Woods* and either *Pollara* or Applicant's Admitted Prior Art.

(4) Whether claims 41 and 43 were properly rejected under 35 U.S.C. § 103(a) as being unpatentable over *Shapiro* in view of *Woods* and either *Pollara* or Applicant's Admitted Prior Art and further in view of *Ormsby*.

(5) Whether claims 51 and 52 were properly rejected under 35 U.S.C. § 103(a) as being unpatentable over *Shapiro* in view of *Woods* and either *Pollara* or Applicant's Admitted Prior Art in further view of *Zhang*.

(6) Whether claims 25-31 were properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Shapiro in view of *Woods* and *Ormsby* and either *Pollara* or Applicant's Admitted Prior Art in further view of either *Hartung* or *Shinichi*.

VII. <u>GROUPING OF CLAIMS</u>

The claims do not stand or fall together. For purposes of this appeal:

Claims 1, 4-8, 12, 13, 15-38 stand or fall together as Claim Group I;

Claims 44-50 stand or fall together as Claim Group II;

Claims 39, 40 and 42 stand or fall together as Claim Group III;

Claims 41 and 43 stand or fall together as Claim Group IV;

Claims 51 and 52 stand or fall together as Claim Group V; and

Claims 25-31 stand or fall together as Claim Group VI.

Reasons for separate patentablity of the above-indicated Claim Groups I-VI are presented in the arguments section pursuant to 37 C.F.R. § 1.192(c)(5).

VIII. ARGUMENTS

During prosecution of the present U.S. Patent application, it appears that the Examiner has either confused, or treated as equivalent, ***integer coefficients*** resulting from a wavelet transform and the implementation of the wavelet transform in ***integer arithmetic***. Some of the references relied upon to reject the claims on appeal disclose transforms resulting in integer coefficients. However, many of the independent claims (and through dependency, the dependent claims) recite language such as, for example, "an overlapped reversible wavelet transform to the input data to produce a series of coefficients, wherein the overlapped reversible wavelet transform is implemented in ***integer arithmetic*** such that, with integer coefficients, integer input data is losslessly recoverable."

Page 26 of the Detailed Description provides an example of an equation suitable for use as a reversible filter when implemented in integer arithmetic. As stated on page 27 of the Detailed description the transform:

$$\begin{cases} h_0(Z) = \frac{1}{2}\left(1 + Z^{-1}\right) \\ h_1(Z) = \frac{1}{4}\left(-\frac{1}{2}\left(1 + Z^{-1}\right) + 4\left(Z^{-2} - Z^{-3}\right) + \frac{1}{2}\left(Z^{-4} + Z^{-5}\right)\right) \end{cases}$$

can be used to provide a reversible transform in which the results from the low-pass filter ($h_0(Z)$) may be used twice (in the first and third terms) of the high pass filter ($h_1(Z)$). Therefore, only two additional additions must be performed to generate the results of the high-pass filter. Other filters can be used and the general requirements of suitable filters are set forth on pages 27-30.

As a preliminary matter, Applicant submits that the rejections are the result of impermissible hindsight. It is well settled in patent law that there must be something in the prior art as a whole to provide the motivation for, or suggest the desirability of, making the modification suggested by the Examiner. See, for example, Fromson v. Advanced Offset Plate, Inc., 225 U.S.P.Q. 26, 31 (Fed. Cir. 1985). It is well settled that

> [i]t is impermissible within the framework of § 103 to pick and choose from any one reference only so much of it as will support a given position, to the exclusion of other parts necessary to the full appreciation of what such a reference fairly suggests to one of ordinary skill in the art.

In re Wasselau, 147 U.S.P.Q. 391, 393 (C.C.P.A 1965).

Applicant respectfully contends that he Examiner's combination of so many cited references could only have been accomplished through carefully considered hindsight using Applicant's claims as a reconstructive guide. It is impermissible to use the claimed invention as an instruction manual or "template" to piece together the teachings of the prior art in order to render the claimed invention obvious. In re Fritch, 972 F. 2d 1260, 23 U.S.P.Q. 2d 1780 (Fed. Cir. 1992).

A. REJECTION OF CLAIMS 1, 4-8, 12, 13 AND 15-38 AS BEING UNPATENTABLE OVER THE COMBINATION OF *SHAPIRO* IN VIEW OF *WOODS* AND *ORMSBY* AND EITHER *POLLARA* OR APPLICANT'S ADMITTED PRIOR ART IS IMPROPER BECAUSE NO COMBINATION OF THESE REFERENCES TEACHES OR SUGGESTS LOSSLESS, REVERSIBLE WAVELETS IMPLEMENTED IN INTEGER ARITHMETIC.

In the Final Office Action mailed March 19, 2002, claims 1, 4-8, 12, 13 and 15-38 (Claim Group I) were rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of *Shapiro* in view of *Woods*, *Ormsby* and either *Pollara* or Applicants' Admitted Prior Art. Appellants respectfully submit that the claims of Claim Group I are not obvious by the references relied upon for at least the reasons set forth below.

Claim 1 recites:

> applying an overlapped reversible wavelet transform to the input data to produce a series of coefficients, ***wherein the overlapped reversible wavelet transform is implemented in integer arithmetic*** such that, with integer coefficients, integer input data is losslessly recoverable; and
>
> compressing the series of coefficients into data representing a compressed version of the input data, including context modeling bits of each of the series of coefficients based on known coefficients in other frequency bands and neighboring coefficients in the same frequency band.

Thus, Applicants claim use of an overlapped reversible wavelet transform implemented in integer arithmetic. By using a reversible wavelet transform, lossless compression can be accomplished with finite precision arithmetic.

Claim 8 recites decompression and reconstruction of data transformed and compressed using an overlapped reversible wavelet transform implemented in integer arithmetic. Specifically, claim 8 recites use of an overlapped inverse reversible wavelet transform implemented in integer arithmetic. Claims 12, 13, 17 and 23 also recite

reversible wavelet transforms implemented in integer arithmetic. Claim 22 also recites an inverse reversible wavelet transform implemented in integer arithmetic.

Applicants must point out that the J. W. Woods paper cited by *Shapiro* is <u>not</u> the J. W. Woods paper cited in the Office Actions. *Shapiro* cites reference [32] as support for filter design. The reference section of *Shapiro* recites the following:

> [32] J. W. Woods, Ed., *Subband Image Coding*, Boston, MA: Kluwer, ***<u>1991</u>***.

See page 3462, second column (emphasis added). The reference cited in the Office Action is J. W. Woods and S. D. O'Neil, "*Subband coding of images*," IEEE Trans. Acoustics, Speech, and Sig. Proc., vol. 34, pp. 1278-1288, Oct. ***<u>1986</u>***, which is clearly a different reference. Therefore, **the reasoning that *Woods* should be combined with *Shapiro* provided in the Final Office Action is faulty**.

Nothing in either *Shapiro* or *Woods* (as cited in the Final Office Action, not by *Shapiro*) suggests the combination proposed by the Final Office Action, Applicants submit that combination of *Shapiro* and *Woods* is improper for lack of motivation to combine. Something in the prior art must suggest the desirability, and thus the obviousness, of making the combination proposed in an Office Action. <u>Uniroyal, Inc. v. Rudkin-Wiley Corp.</u>, 837 F.2d 1044, 5 USPQ2d 1434, 1438 (CAFC 1988). Therefore, the Office Actions have failed to provide adequate motivation to combine these references.

Shapiro discloses a frequency-based model called Zerotree using two lists, a dominant list and a subordinate list, to store all coefficients. The model of *Shapiro* can be used for compression of ***transformed*** coefficients. See Detailed Description at page

50, line 21 to page 51, line 10. ***Applicants agree with the Final Office Action that*** **Shapiro** ***does not disclose an overlapped reversible wavelet transform that is implemented in integer arithmetic.***

The Final Office Action states:

> Integer coefficients produced in a reversible transform is basically indicated as prior art by the Applicant on at least page 22 of the Applicant's specification, and is further not critical nor provides unexpected results...

See page 3. Whether or not this statement it true, it is irrelevant because claim 1 recites an ***overlapped*** reversible wavelet transform that is ***implemented in integer arithmetic***, which is not the same as integer coefficients. ***The S-transform as described on page 22 of the specification is a non-overlapping transform***. See specification at page 23, lines 9-10. Claims 1, 12, 13, 17 and 23 explicitly recite an overlapping transform and claims 8 and 22 recite an overlapping inverse transform. Therefore, the S-transform cannot be used to cure the deficiencies of *Shapiro*, which also lacks an overlapped reversible transform.

The Advisory Action mailed in response to Applicant's Response of July 19, 2002 states:

> Applicant admits that integer arithmetic such as by rounding is provided by the prior art. The claim never elaborates on how the integers are different than that of the prior art.

Page 22 of the Detailed Description describes a transform (the S-transform) that, ***through truncation and rounding***, can provide integer coefficients. Truncation and rounding results in the loss of data, which cannot be recovered. Therefore, truncation and rounding are generally inconsistent with a losslessly recoverable transform, as claimed.

Pollara discloses an image compression algorithm that uses quadrature mirror filters with integer coefficients. Specifically, *Pollara* discloses a JPEG-like technique, which is ***not*** a losslessly recoverable technique. Therefore, as with *Shapiro* and *Woods* discussed above, *Pollara* does not disclose a wavelet transform is implemented in integer arithmetic such that with integer coefficients, integer input data is losslessly recoverable.

None of the references (*Shapiro*, *Woods*, *Pollara*, Applicant's Admitted Prior Art) cited in the Final Office Action, tech or suggest a wavelet transform is implemented in integer arithmetic such that with integer coefficients, integer input data is losslessly recoverable. Because each of these references is lacking an element of the independent claims of Claim Group I, no combination of the references can render the claims of Claim Group I obvious.

Claims 1, 8, 12, 13, 17, 22 and 23 recite further that the context modeling of bits of coefficients generated by the claimed overlapped reversible wavelet transform is based on known coefficients in other frequency bands and neighboring coefficients in the same frequency band. The Final Office Action states that *Shapiro* does not discloses context modeling based on known coefficients in other frequency bands and neighboring coefficients in the same frequency band. Applicants agree with this assertion from the Final Office Action.

The Office Action states that *Ormsby* should be combined with *Shapiro* to disclose context modeling because *Ormsby* improves upon a reference (*Whitten*) cited by *Shapiro*. However, there must be some supporting teaching in the prior art for the proposed combination of references to be proper. *In re Newell*, 13 USPQ 2d 1248 (Fed. Cir. 1989). While both *Shpiro* and *Ormsby* cite this common reference, nothing in

Ormsby explicitly suggests that the teachings of *Whitten* are improved upon. **The text of *Ormsby* does not even mention *Whitten*.** Therefore, the Office Action fails to suggest a motivation to combine *Ormsby* with *Shapiro*.

Even if combination of *Ormsby* with *Shapiro* were proper, *Ormsby* does not disclose an overlapped wavelet transform implemented in integer arithmetic. Therefore, no combination of *Shapiro*, *Woods*, *Ormsby* and *Pollara* or Applicants' Admitted Prior Art teaches or suggests the invention as claimed in claims 1, 8, 12, 13, 17 and 22.

Claims 4-7, 25 and 33 depend from claim 1. Claims 26 and 34 depend from claim 8. Claim 27 depends from claim 12. Claims 15, 16, 28 and 35 depend from claim 13. Claims 18-21, 29 and 36 depend from claim 17. Claims 30 and 37 depend from claim 22. Claims 24, 31 and 38 depend from claim 23. Because dependent claims include the limitations of the claims from which they depend, Applicants submit that claims 4-7, 15, 16, 18-21 and 23-38 are not rendered obvious by the combination of *Shapiro*, *Woods*, *Ormsby* and *Pollara* or Applicants' Admitted Prior Art for at least the reasons set forth above.

For at least the foregoing reasons Appellants submit that no combination of *Shapiro*, *Woods*, *Ormsby* and *Pollara* or Applicants' Admitted Prior Art teaches or suggests the invention as claimed in claims 1, 4-8, 12, 13 and 15-38. Appellants therefore request that the Board of Patent Appeals and Interferences overrule the Examiner's rejection of claims 1, 4-8, 12, 13 and 15-38 under 35 U.S.C. § 103(a).

B. REJECTION OF CLAIMS 44-50 AS BEING UNPATENTABLE OVER THE COMBINATION OF *SHAPIRO* IN VIEW OF *WOODS* AND *ORMSBY* AND EITHER *POLLARA* OR APPLICANT'S ADMITTED

PRIOR ART AND FURTHER IN VIEW OF *ZHANG* IS IMPROPER BECAUSE NO COMBINATION OF THESE REFERENCES TEACHES OR SUGGESTS LOSSLESS, REVERSIBLE WAVELETS IMPLEMENTED IN INTEGER ARITHMETIC HAVING A DETERMINANT OF ONE

In the Final Office Action mailed March 19, 2002, claims 44-50 (Claim Group II) were rejected as being unpatentable over *Shapiro* in view of *Woods*, *Ormsby* and either *Pollara* or Applicant's Admitted Prior Art in further view of *Zhang*. Appellants respectfully submit that the claims of Claim Group II are not obvious by the references relied upon for at least the reasons set forth below.

Claims 44-50 depend from claims 1, 8, 12, 13, 17, 22 and 32, respectively. Claims 1, 8, 12, 13, 17, 22 and 32 belong to Claim Group I, which is discussed above. The arguments above with respect to Claim Group I are incorporated by reference with respect to Claim Group II.

As discussed above, no combination of *Shapiro*, *Woods*, *Ormsby*, *Pollara* and Applicant's Admitted Prior Art teaches or suggests the inventions as claimed in claims 1, 8, 12, 13, 17, 22 and 32. Claims 44-50 depend from claims 1, 8, 12, 13, 17, 22 and 32, respectively and add the limitation that the determinant of the overlapped reversible wavelet transform (implemented in integer arithmetic) is one.

Shapiro recites:

> ...using properly scaled coefficients, the transformation matrix for a discrete wavelet transform obtained using these filters is so close to unitary that it can be treated as unitary for the purpose of <u>lossy</u> compression.

See page 3448, first full paragraph, left column (emphasis added). Thus, even if *Shapiro* suggests use of a transform with a determinant of 1, that is for lossy compression, not for lossless compression as recited in the independent claims. Therefore, in addition to the

shortcomings discussed above, *Shapiro* does not teach or suggest the limitations of claims 44-50.

Zhang is cited to teach use of a transform with a determinant of 1. A determinant is a square array of numbers having a numerical value, Δ, that is a difference of products of numbers within the array. As a 2x2 example the determinant of

$$\begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix}$$

is $a_{11}a_{22} - a_{12}a_{21}$.

Zhang does not mention the evaluation of a determinant, **nor does *Zhang* include any use of an array from which a determinant can be inferred**. Therefore, *Zhang* in combination with *Shapiro*, *Woods*, *Ormsby*, *Pollara*, Applicant's Admitted Prior Art fails to render claims 44-50 obvious.

For at least the foregoing reasons Appellants submit that no combination of *Shapiro*, *Woods*, *Ormsby* and *Pollara* or Applicants' Admitted Prior Art and *Zhang* teaches or suggests the invention as claimed in claims 44-50. Appellants therefore request that the Board of Patent Appeals and Interferences overrule the Examiner's rejection of claims 44-50 under 35 U.S.C. § 103(a).

C. REJECTION OF CLAIMS 39, 40 AND 42 AS BEING UNPATENTABLE OVER THE COMBINATION OF *SHAPIRO* IN VIEW OF *WOODS* AND EITHER *POLLARA* OR APPLICANT'S ADMITTED PRIOR ART FURTHER IN VIEW OF *HARTUNG* OR *SHINICHI* IS IMPROPER BECAUSE NO COMBINATION OF THESE REFERENCES TEACHES OR SUGGESTS LOSSLESS, REVERSIBLE WAVELETS IMPLEMENTED IN INTEGER ARITHMETIC

In the Final Office Action mailed March 19, 2002, claims 39, 40 and 42 (Claim Group III) were rejected as being unpatentable over *Shapiro* in view of *Woods* and either *Pollara* or Applicant's Admitted Prior Art. Appellants respectfully submit that the claims of Claim Group III are not obvious by the references relied upon for at least the reasons set forth below.

Claim 39 recites:

> a reversible Two/Ten wavelet filter, wherein the reversible Two/Ten wavelet filter is implemented in integer arithmetic such that with integer coefficients, an integer signal is losslessly recoverable; and
>
> a coder coupled to the Two/Ten filter to code coefficients generated by the Two/Ten wavelet transform filter.

Thus, Applicants claim a reversible wavelet filter implemented in integer arithmetic and a coder coupled to the transform filter. Claim 40 depends from claim 39. Claim 42 recites an inverse reversible wavelet filter implemented in integer arithmetic.

As discussed above, no combination of *Shapiro*, *Woods* and either *Pollara* or Applicant's Admitted Prior Art teaches or suggests a reversible wavelet filter transform implemented in integer arithmetic. Therefore, no combination of *Shapiro*, *Woods* and either *Pollara* or Applicant's Admitted Prior Art teaches or suggests use of a reversible wavelet transform coupled with a coder. Further, neither *Hartung* nor *Shinichi* teaches or suggests a reversible Two/Ten transform. Therefore, no combination of *Shapiro*, *Woods* and either *Pollara* or Applicant's Admitted Prior Art and *Hartung* or *Shinichi* can teach or suggest the invention as claimed in claims 39, 40 and 42. Appellants therefore request that the Board of Patent Appeals and Interferences overrule the Examiner's rejection of claims 39, 40 and 42 under 35 U.S.C. § 103(a).

D. REJECTION OF CLAIMS 41 AND 43 AS BEING UNPATENTABLE OVER THE COMBINATION OF *SHAPIRO* IN VIEW OF *WOODS* AND EITHER *POLLARA* OR APPLICANT'S ADMITTED PRIOR ART AND *HARTUNG* OR *SHINICHI* AND FURTHER IN VIEW OF *ORMSBY* IS IMPROPER BECAUSE NO COMBINATION OF THESE REFERENCES TEACHES OR SUGGESTS LOSSLESS, REVERSIBLE WAVELETS IMPLEMENTED IN INTEGER ARITHMETIC AND CONTEXT MODELING OF BITS OF COEFFICIENTS BASED ON KNOWN COEFFICIENTS IN OTHER FREQUENCY BANDS AND NEIGHBORING COEFFICIENTS IN THE SAME FREQUENCY BAND

In the Final Office Action mailed March 19, 2002, claims 41 and 43 (Claim Group IV) were rejected as being unpatentable over *Shapiro* in view of *Woods* and either *Pollara* or Applicant's Admitted Prior Art in further view of *Ormsby*. Appellants respectfully submit that the claims of Claim Group VI are not obvious by the references relied upon for at least the reasons set forth below.

Claims 41 and 43 depend from claims 39 and 42, respectively. Claims 39 and 42 belong to Claim Group III, which is discussed above. The arguments above with respect to Claim Group III are incorporated by reference with respect to Claim Group IV. Claims 41 and 43 recite the limitation that the context model of the independent claims models bits of coefficients based on known coefficients in other frequency bands and neighboring coefficients in the same frequency band.

The Office Action states that *Ormsby* should be combined with *Shapiro* to disclose context modeling because *Ormsby* improves upon a reference (*Whitten*) cited by *Shapiro*. However, there must be some supporting teaching in the prior art for the proposed combination of references to be proper. *In re Newell*, 13 USPQ 2d 1248 (Fed. Cir. 1989). While both *Shpiro* and *Ormsby* cite this common reference, nothing in *Ormsby* explicitly suggests that the teachings of *Whitten* are improved upon. The text of

Ormsby does not even mention *Whitten*. Therefore, the Office Action fails to suggest a motivation to combine *Ormsby* with *Shapiro*. **Even if combination of *Ormsby* with *Shapiro* were proper, *Ormsby* does not disclose an overlapped wavelet transform implemented in integer arithmetic**. Therefore, *Ormsby* does not cure the deficiencies of *Shapiro*.

For at least the foregoing reasons Appellants submit that no combination of *Shapiro*, *Woods*, *Ormsby* and *Pollara* or Applicants' Admitted Prior Art and *Zhang* teaches or suggests the invention as claimed in claims 41 and 43. Appellants therefore request that the Board of Patent Appeals and Interferences overrule the Examiner's rejection of claims 41 and 43 under 35 U.S.C. § 103(a).

E. REJECTION OF CLAIMS 51 AND 52 AS BEING UNPATENTABLE OVER THE COMBINATION OF *SHAPIRO* IN VIEW OF *WOODS* AND EITHER *POLLARA* OR APPLICANT'S ADMITTED PRIOR ART AND *HARTUNG* OR *SHINICHI* AND FURTHER IN VIEW OF *ZHANG* IS IMPROPER BECAUSE NO COMBINATION OF THESE REFERENCES TEACHES OR SUGGESTS LOSSLESS, REVERSIBLE WAVELETS IMPLEMENTED IN INTEGER ARITHMETIC HAVING A DETERMINANT OF ONE

In the Final Office Action mailed March 19, 2002, claims 51 and 52 (Claim Group V) were rejected as being unpatentable over *Shapiro* in view of *Woods* and either *Pollara* or Applicant's Admitted Prior Art in further view of *Hartung* or *Shinichi*. Appellants respectfully submit that the claims of Claim Group V are not obvious by the references relied upon for at least the reasons set forth below.

Claims 51 and 52 depend from claims 39 and 42, respectively. Claims 39 and 42 belong to Claim Group III, which is discussed above. The arguments above with respect to Claim Group III are incorporated by reference with respect to Claim Group V.

As discussed above, *Shapiro* does not teach or suggest use of a transform with a determinant of 1, that is for lossy compression, not for lossless compression as recited in the independent claims. Also as mentioned above, *Zhang* does not mention the evaluation of a determinant, nor does *Zhang* include an array from which a determinant can be inferred. Therefore, *Zhang* in combination with *Shapiro*, *Woods*, *Ormsby*, *Pollara*, Applicant's Admitted Prior Art and *Hartung* or *Shinichi* fails to render claims 51 and 52 obvious. Appellants therefore request that the Board of Patent Appeals and Interferences overrule the Examiner's rejection of claims 51 and 52 under 35 U.S.C. § 103(a).

F. REJECTION OF CLAIMS 25-31 AS BEING UNPATENTABLE OVER THE COMBINATION OF *SHAPIRO* IN VIEW OF *WOODS* AND *ORMSBY* AND EITHER *POLLARA* OR APPLICANT'S ADMITTED PRIOR ART AND FURTHER IN VIEW OF EITHER *HARTUNG* OR *SHINICHI* IS IMPROPER BECAUSE NO COMBINATION OF THESE REFERENCES TEACHES OR SUGGESTS LOSSLESS, REVERSIBLE WAVELETS IMPLEMENTED IN INTEGER ARITHMETIC AND CONTEXT MODELING OF BITS OF COEFFICIENTS BASED ON KNOWN COEFFICIENTS IN OTHER FREQUENCY BANDS AND NEIGHBORING COEFFICIENTS IN THE SAME FREQUENCY BAND

In the Final Office Action mailed March 19, 2002, claims 25-31 (Claim Group VI) were rejected as being unpatentable over *Shapiro* in view of *Woods*, *Ormsby* and either *Pollara* or Applicant's Admitted Prior Art in further view of either *Hartung* or

Shinichi. Appellants respectfully submit that the claims of Claim Group VI are not obvious by the references relied upon for at least the reasons set forth below.

Claims 25-31 were also rejected for the reasons set forth above with respect to the claims that belong to Claim Group I. Therefore, the arguments above with respect to Claim Group I are incorporated by reference with respect to Claim Group VI.

Hartung and *Shinichi* are cited to teach Two-Ten transforms. However, neither *Hartung* nor *Shinichi* teaches or suggests a reversible Two/Ten transform. Therefore, no combination of *Shaprio*, *Woods*, *Ormsby*, *Pollara*, Applicant's Admitted Prior Art, *Hartung* or *Shinichi* teaches or suggests the invention as claimed in claims 25-31. Appellants therefore request that the Board of Patent Appeals and Interferences overrule the Examiner's rejection of claims 25-31 under 35 U.S.C. § 103(a).

IX. CONCLUSION

Appellants respectfully submit that all the appealed claims in this application are patentable and requests that the Board of Patent Appeals and Interferences overrule the Examiner and direct allowance of the rejected claims.

This brief is submitted in triplicate, along with a check for $330.00 to cover the appeal fee for one other than a small entity as specified in 37 C.F.R. § 1.17(f). Please charge any shortages and credit any overcharges to our Deposit Account No. 02-2666.

Respectfully submitted,
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN, LLP

Date: 10/9/03

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10-9-03
Date

APPENDIX A: CLAIMS ON APPEAL

1. A method for encoding input data comprising:

applying an overlapped reversible wavelet transform to the input data to produce a series of coefficients, wherein the overlapped reversible wavelet transform is implemented in integer arithmetic such that, with integer coefficients, integer input data is losslessly recoverable; and

compressing the series of coefficients into data representing a compressed version of the input data, including context modeling bits of each of the series of coefficients based on known coefficients in other frequency bands and neighboring coefficients in the same frequency band.

4. The method defined in Claim 1 wherein applying the overlapped reversible wavelet transform comprises applying to the input data a plurality of non-minimal length reversible filters comprised of a plurality of one-dimensional filters.

5. The method defined in Claim 1 wherein the input data comprises image data.

6. The method defined in Claim 1 wherein compressing comprises performing big significance embedding on the series of coefficients.

7. The method defined in Claim 1 further comprising:

decompressing the losslessly compressed version of the input data into

transformed signals; and

generating the input data from the transformed signals into a

reconstructed version of the input data using an inverse reversible wavelet

transform.

8. A method for decoding data into original data comprising:

decompressing a compressed version of input data into a plurality of transformed signals, including context modeling bits of the plurality of transformed signals based on known transformed signals in other frequency bands and neighboring transformed signals in the same frequency band; and

generating a reconstructed version of original data from the plurality of transformed signals with an overlapped inverse reversible wavelet transform, wherein the overlapped inverse reversible wavelet transform is implemented in integer arithmetic such that, with integer coefficients, integer reconstructed original data is losslessly recoverable.

12. A method for processing input data comprising:

generating a first plurality of transformed signals in response to the input data with a reversible overlapped wavelet transform using a pair of non-minimal length reversible filters, implemented in integer arithmetic such that, with integer signals, integer input data is losslessly recoverable;

compressing the first plurality of transformed signals into data representing a compressed version of the input data, including context modeling the first plurality of

transformed signals based on known transformed signals in other frequency bands and neighboring transformed signals in the same frequency band;

decompressing the compresses version of the input data into a second plurality of transformed signals; and

generating the input data from the second plurality of transformed signals into a reconstructed version of the input data with an inverse reversible overlapped wavelet transform using a second pair of non-minimal length reversible filters.

13. A method for encoding input data comprising:

transform encoding the input data into a series of coefficients with an overlapped reversible wavelet transform, wherein the overlapped reversible wavelet transform is implemented in integer arithmetic such that, with integer coefficients, integer input data is losslessly recoverable; and

embedded coding the series of coefficients, including ordering the series of coefficients, performing bit significance embedding on the series of coefficients, wherein a first type of embedded coding is performed on a first portion of the data and a second type of embedded coding is performed on a second portion of data using context modeling based upon known coefficients in other frequency bands and neighboring coefficients in the same frequency band.

15. The method defined in Claim 13 wherein the first type of embedded coding comprises tree coding.

16. The method defined in Claim 13 wherein embedded coding comprises formatting the series of coefficients into sign-magnitude format.

17. A method for encoding input data comprising:

transforming input data into a series of coefficients with an overlapped reversible wavelet transform, wherein the overlapped reversible wavelet transform is implemented in integer arithmetic such that, with integer coefficients, integer input data is losslessly recoverable;

converting the series of coefficients into sign-magnitude format to produce a series of formatted coefficients;

coding a first portion of the series of coefficients using a first type of embedded coding to produce a first bit stream;

coding a second portion of the series of formatted coefficients using a second type of embedded coding that models data using known coefficients in other frequency bands and neighboring coefficients in the same frequency to produce a second bit stream; and

coding the first bit stream and second bit stream into a single bit stream.

18. The method in Claim 17 further comprising entropy coding the single bit stream.

19. The method defined in Claim 17 wherein the first type of coding comprises tree order coding.

20. The method defined in Claim 17 wherein the first portion comprises the bits of the series of formatted coefficients that include the most significant bit of each of the series of coefficients and the second portion comprises the bits of the series of formatted coefficients that are not in the first portion.

21. The method defined in Claim 17 wherein the single bit stream represents a losslessly compressed version of the input data.

22. An encoder for encoding input data into a compressed data stream, said encoder comprising:

a reversible wavelet filter to transform the input into a plurality of coefficients, wherein the reversible wavelet filter is implemented in integer arithmetic such that, with integer coefficients, integer input data is losslessly recoverable;

an embedded coder coupled to the reversible wavelet filter to perform embedded coding on the plurality of coefficients to generate a bit stream, when the embedded coder comprises a context model to model data based on known coefficients in other frequency bands and neighboring coefficients in the same frequency band; and

an entropy coder coupled to the embedded coder to perform entropy coding on the bit stream to create coded data.

23. An encoder for encoding input data comprising:

a transform coder coupled to receive the input data and generate a series of coefficients to represent a decomposition of the input data using an overlapped reversible

wavelet transform, wherein the overlapped reversible wavelet transform is implemented in integer arithmetic such that, with integer coefficients, integer input data is losslessly recoverable; and

an embedded coder coupled to receive the series of coefficients and perform bit-significance encoding on the series of coefficients to create coded data, when the embedded coder comprises a context model to model data based on known coefficients in other frequency bands and neighboring coefficients in the same frequency band, the embedded coder producing the coded data as the series of coefficients are received.

24. The encoder defined in Claim 23 wherein the transform coder and the embedded coder operate to generate coded data from the input data on a single pass through the data.

25. The method defined in Claim 1 wherein the overlapped reversible wavelet transform comprises a Two, Ten transform.

26. The method defined in Claim 8 wherein the overlapped inverse reversible wavelet transform comprises a Two, Ten transform.

27. The method defined in Claim 12 wherein the overlapped reversible wavelet transform comprises a Two, Ten transform.

28. The method defined in Claim 13 wherein the overlapped reversible wavelet transform comprises a Two, Ten transform.

29. The method defined in Claim 17 wherein the overlapped reversible wavelet transform comprises a Two, Ten transform.

30. The method defined in Claim 22 wherein the reversible wavelet filter comprises a Two, Ten transform.

31. The method defined in Claim 23 wherein the overlapped reversible wavelet transform comprises a pair of non-minimal length reversible filters that operate as a Two, Ten transform filter pair.

32. A decoder for decoding input data comprising:

a decompressor to decompress a compressed version of input data into a plurality of coefficients using context modeling based on known coefficients in other frequency bands and neighboring coefficients in the same frequency band; and

an overlapped inverse reversible wavelet transform coupled to the decompressor to generate a reconstructed version of original data from the plurality of coefficients, wherein the overlapped inverse reversible wavelet transform is implemented in integer arithmetic such that, with integer coefficients, integer reconstructed original data is losslessly recoverable.

33. The method defined in Claim 1 wherein applying an overlapped reversible wavelet transform to the input data comprises applying non-minimal length reversible filters to produce the series of coefficients.

34. The method defined in Claim 8 wherein generating a reconstructed version of the original data comprises applying non-minimal length reversible filters to produce the series of coefficients.

35. The method defined in Claim 13 wherein transformed coding comprises applying a pair of non-minimal length reversible filters to transform code the input data into the series of coefficients.

36. The method defined in Claim 17 wherein transformed coding comprises applying a pair of non-minimal length reversible filters to transform code the input data into the series of coefficients.

37. The method defined in Claim 22 wherein the reversible wavelet filter comprises a pair of non-minimal length reversible filters.

38. The method defined in Claim 23 wherein the transform coder comprises a pair of non-minimal length reversible filters.

39. A System comprising:

a reversible Two/Ten wavelet filter, wherein the reversible Two/Ten wavelet filter is implemented in integer arithmetic such that with integer coefficients, an integer signal is losslessly recoverable; and

a coder coupled to the Two/Ten filter to code coefficients generated by the Two/Ten wavelet transform filter.

40. The system defined in Claim 39 wherein the coder comprises a context model, and a bit generator coupled to the context model.

41. The system defined in Claim 40 wherein the context model models bits of coefficients based on known coefficients in other frequency bands and neighboring coefficients in the same frequency band.

42. A decoding system comprising:

a decoder to decode compressed data into a series of coefficients; and

an inverse Two/Ten reversible wavelet filter coupled to the decoder, wherein the inverse Two/Ten reversible wavelet transform is implemented in integer arithmetic such that with integer coefficients, integer reconstructed original data is losslessly recoverable.

43. The method defined in Claim 42 wherein the decoder comprises a context model to model data based on known coefficients in other frequency bands and neighboring coefficients in the same frequency band.

44. The method defined in Claim 1 wherein the overlapped reversible wavelet transform is an efficient reversible transform in that it has its determinant is equal to 1.

45. The method defined in Claim 8 wherein the overlapped reversible wavelet transform is an efficient reversible transform in that its determinant is equal to 1.

46. The method defined in Claim 12 wherein the overlapped reversible wavelet transform is an efficient reversible transform in that its determinant is equal to 1.

47. The method defined in Claim 13 wherein the overlapped reversible wavelet transform is an efficient reversible transform in that its determinant is equal to 1.

48. The method defined in Claim 17 wherein the overlapped reversible wavelet transform is an efficient reversible transform in that its determinant is equal to 1.

49. The encoder defined in Claim 22 wherein the reversible wavelet filter performs an overlapped reversible wavelet transform this is efficient in that its determinant is equal to 1.

50. The decoder defined in Claim 32 wherein the overlapped inverse reversible wavelet transform is an efficient reversible transform in that its determinant is equal to 1.

51. The system defined in Claim 39 wherein the reversible Two/Ten variable wavelet filter performs an overlapped reversible wavelet transform is an efficient reversible transform in that its determinant is equal to 1.

52. The decoding system defined in Claim 42 wherein the overlapped reversible wavelet transform is an efficient reversible transform in that its determinant is equal to 1.

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FEE TRANSMITTAL FOR FY 2004

(FY 2004 Beg 10/01/2003)

TOTAL AMOUNT OF PAYMENT ($) 1,660.00

Complete if Known:
Application No. 08/941,466
Filing Date September 30, 1997
First Named Inventor Ahmad Zandi
Examiner Name T. Johnson
Art Unit 2723
Attorney Docket No. 074451.P024C

_____ **Applicant claims small entity status. See 37 CFR 1.27.**

METHOD OF PAYMENT (check all that apply)

x **Check** _____ **Credit Card** _____ **Money Order** _____ **Other** _____ **None**

X **Deposit Account**
Deposit Account Number : 02-266
Deposit Account Name: _____

X **The Director is Authorized to do the following with respect to the above-identified Deposit Account:**
- _____ **Charge fee(s) indicated below.**
- X **Credit any overpayments.**
- X **Charge any additional fees during the pendency of this application.**
- X **Any concurrent or future reply that requires a petition for extension of time should be treated as incorporating an appropriate petition for extension of time and all required fees should be charged.**
- _____ **Charge fee(s) indicated below except for the filing fee.**

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	770	2001	385	Utility application filing fee	
1002	340	2002	170	Design application filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional application filing fee	

SUBTOTAL (1) $ 0

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

			Extra Claims		Fee from below		Fee Paid
Total Claims	_____	– 20** =	_____	X	_____	=	_____
Independent Claims	_____	– 3** =	_____	X	_____	=	_____
Multiple Dependent					_____	=	_____

****Or number previously paid, if greater; For Reissues, see below.**

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple dependent claim, if not paid
1204	86	2204	43	**Reissue independent claims over original patent
1205	18	2205	9	**Reissue claims in excess of 20 and over original patent

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SUBTOTAL (2) $ 0

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FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for ex parte reexamination	
1813	8,800	1813	8,800	Request for inter parties reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1,480	2254	740	Extension for reply within fourth month	
1255	2,010	2255	1,005	Extension for reply within fifth month	
1401	330	2401	165	Notice of Appeal	
1402	330	2402	165	Filing a brief in support of an appeal	330.00
1403	290	2403	145	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive – unavoidable	
1453	1,330	2453	665	Petition to revive - unintentional	1,330.00
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	770	2809	385	For filing a submission after final rejection (see 37 CFR 1.129(a))	
1814	110	2814	55	Statutory Disclaimer	
1810	770	2810	385	For each additional invention to be examined (see 37 CFR 1.129(b))	
1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	
1504	300	1504	300	Publication fee for early, voluntary, or normal pub.	
1505	300	1505	300	Publication fee for republication	
1803	130	1803	130	Request for voluntary publication or republication	
1808	130	1808	130	Processing fee under 37 CFR 1.17(i) (except provisionals)	
1454	1,330	1454	1,330	Acceptance of unintentionally delayed claim for priority	

Other fee (specify) ____________________ ______

Other fee (specify) ____________________ ______

SUBTOTAL (3) $ 1,660.00

*Reduced by Basic Filing Fee Paid

SUBMITTED BY:

Typed or Printed Name: Michael J. Mallie

Signature: ____________ **Date:** 10/9/03

Reg. Number: 36,591 **Telephone Number:** (408) 720-8300

Send to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

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